

EFFECTS OF VARIOUS TRAINING TECHNIQUES ON GROWTH AND YIELD OF DOUBLE RED LEBANON APPLE CULTIVAR

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Abstract

Maximum plant height and spread were observed in Central Leader System of training in Double Red Lebanon cultivar of apple. Maximum fruit size index (83.00 mm), fruit weight (259.20 gm), number of fruits per plant (200) and yield (51.84 kg/plant) were recorded in plants trained as Modified Leader System followed by Open Centre System, while all the above mentioned parameters were found minimum in Central Leader System during both years of studies. Stock and scion girths and Total Soluble Solids (TSS) did not respond at all with various training techniques. All the tested training techniques had no profound effect on blooming period and maturity of Double Red Lebanon apple cultivar. The fruit harvested from the plants trained as Central Leader System and Open Centre System had deep red color with red streaks while in modified leader system the color of the fruit was shining red with red streaks.

Introduction

Pruning of apple is often ignored by many orchardists mainly because they are unaware of the objectives of this practice. The purpose of pruning of young non-bearing apple trees is to train or shape them in such a way that a strong frame-work consisting of stout limbs is build to support maximum crop of fruit without breakage. The pruning of bearing tree is practiced to keep the treetops low so as to facilitate thinning, spraying and picking operations. Moreover, pruning of bearing tree is done to make the tree well opened for penetration of sunlight which in turn promotes better quality and color of the fruit. Above all weak, diseased and undesirable branches are removed and moderate balance is developed between shoot and fruit.

The most common forms of training apple trees are Central Leader System, Open Centre System and Modified Leader System. In the former training method 6 to 10 strong lateral branches spread in all directions. This system is used to get large trees and pruning is done during dormant season (Mitra *et al.*, 1991). In the later system of training, the central leader is removed one meter above the ground and 3 to 5 well spaced scaffold branches are retained. The centre of the tree remains open, permitting adequate sunlight throughout the tree (Ali, 1970). In modified leader system of training, central leader is allowed to grow for few years until 6 to 8 scaffold branches develop around the trunk. The central leader is then cut off. It is also called delayed open centre. In his type of training, the tree develops well spaced limbs with strong crotches (Mian & Nasir, 1987). Rehman (1999) suggested that pruning of apple tree during early August results in improvement of fruit color but the size is greatly reduced in Kaja and Fiesta cultivars. Ghafoor *et al.*, (2001) reported that maximum length of branches were observed in unpruned trees of Falsa while number of fruit per cluster (58.33) and weight of cluster per plant (42.36 gm) and total yield per plant (3.64 kg) were observed in pruning level of 90cm above the ground. Similarly Stino & Barkat (1979) reported that fruit size and fruit weight were greater in pruned trees than unpruned peach trees. Rathore (1991) reported

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that modified central leader system of training is very common in pear and there is little difference in yield of eight years old William's Bon cultivar trees on quince rootstock in various plant training techniques. The present report describes the response of various training techniques on apple plants.

Material and Methods

A field experiment to observe the response of various training techniques on apple plants was carried out in the Experimental Garden, Hill Fruit Research Station, Sunny Bank, Murree during the year 1999-2000.

Eight years old plants of Double Red Lebanon apple cultivar were selected for the study. Plants were planted 20 feet apart and received uniform cultural practices. Six plants were included in each treatment. The experiment was laid out according to Randomized Complete Block Design (RCBD) with three replications. Analysis of variance techniques were adopted at 5% level of probability for data processing (Steel & Torrie, 1990). The following treatments were applied:

- Central leader system** Plants of Double Red Lebanon apples cultivar were planted in mid February 1990. Central shoot along with six strong scaffold branches spreading in all directions were allowed to grow. Only broken, water sprouts and dried limbs were removed during dormant season of every year.
- Open centre system** Plants of Double Red Lebanon apple cultivar were planted in mid February 1990. These plants were cut back 90 cm above the ground and 3-5 well spaced scaffold branches were retained. Only broken, water sprouts and dried limbs were removed during the dormant season of every year.
- Modified leader system** Similarly, plants of Double Red Lebanon apple cultivar were planted in mid February 1990. These plants were cut back 90 cm above the ground after 4 years of plantation in the field. Then six scaffold branches were developed and allowed to grow. Only broken, water sprouts and dried limbs were removed during the dormant season of both year.

Height, spread, stock and scion girths of the plants were taken in cm with the help of measuring tape. Size index of fruits was calculated in mm from length and width measured with the help of Digital Vernier Caliper. Yield was determined both in number and total weight of fruit per tree. Individual fruit weight was also calculated with the help of triple beam balance in gm. Total Soluble Solids (TSS) were determined with Abb's refractometer. Fruit color was observed visually by comparing it with Horticultural color chart as a standard. Maturity was adjusted at getting full size of fruit with maximum TSS.

Results and Discussion

Plant growth: Plant vigor in terms of height and spread of plants as affected by various training techniques were found significant (Table 1). Maximum height of apple plants were recorded which were trained as a central leader system (2.35m) while the minimum in modified leader system (1.73m). Plants either trained as modified leader system or open centre system were statistically at par with each other. Almost similar results were recorded by Ghafoor *et al.*, (2001), who noted that unpruned trees have more vigor than pruned trees. Stock and scion girths of the plants were not affected by different pruning methods.

Table 1. Effect of different methods of training on growth of Double Red Lebanon apple plants.

Treatments	Plant Height (m)		Plant Spread (m)		Scion Girth (cm)		Stock girth (cm)	
	1999	2000	1999	2000	1999	2000	1999	2000
Central leader system	2.35a	2.40a	1.10a	1.12a	9.43	10.50	10.12	11.00
Modified leader system	1.73b	1.76b	0.81b	0.84b	10.33	11.25	10.53	11.75
Open center system	1.82b	1.90b	0.86b	0.90b	11.71	12.50	12.00	13.00
LSD at 5%	0.81	0.25	0.14	0.18	-----	-----	-----	-----

Means sharing a common letter within columns do not differ significantly.

Table 2. Blooming period, maturity and fruit color of Double Red Lebanon apple plants as affected by various training techniques.

Treatments	Blooming period		Maturity		Fruit color	
	1999	2000	1999	2000	1999	2000
Central leader System	Apr. 3 rd week	Apr. 3 rd week	Sept. 3 rd week	Sept. 3 rd week	Deep red with red streaks	
Modified leader system	Apr. 2 nd week	Apr. 2 nd week	Sept. 2 nd week	Sept. 2 nd week	Shining deep red with red streaks	
Open centre system	Apr. 3 rd week	Apr. 3 rd week	Sept. 2 nd week	Sept. 2 nd week	Deep red with red streaks	

Blooming period: Data regarding blooming period and maturity showed that all the tested training techniques have no effect on the Double Red Lebanon cultivar of apple (Table 2). This cultivar bloomed in the third week of April during 1999 and 2000. Similarly, fruit matured during the third week of September.

Fruit color: In contrast to blooming period and maturity, various training techniques affected the skin color of Double Red Lebanon apple fruit (Table 2). The fruit harvested from the plants trained as central leader system and open centre system have deep red color while in modified leader system the color of the fruit is shining deep red with red streaks. Similar results were obtained by Rehman (1999) who also observed that pruning improved the color.

Size index and fruit weight: Different pruning techniques significantly affected size index and individual fruit weight which are the most important yield components (Table 3). During 1999 maximum fruit size index was noted in fruits harvested from the plants either trained as modified leader system (83.00 mm) or open centre system (82.00 mm) whereas the minimum fruit size index were recorded in central leader system (77.00 mm). Almost similar trend was noted during 2000. The maximum weight of individual fruit was noted when plants were trained as modified leader system (259.20 gm) followed by central leader system (240.12 gm) and open centre system (238.00 gm) during first year. Almost similar trend was noted during the second year. These results are not in contrast to Rehman (1999) who concluded that pruning greatly reduced the size of the fruit. These results are also in agreement with the findings of Ghafoor *et al.*, (2001) who reported that the fruit weight was much greater in pruned trees than unpruned trees of Falsa.

Table 3. Size index and fruit weight of Double Red Lebanon apple cultivars as affected by various training techniques.

Treatments	Size Index (mm)		Fruit Weight (gm)	
	1999	2000	1999	2000
Central leader system	77.00b	82.00b	240.12b	242.15b
Modified leader system	83.00a	85.00a	259.20a	280.50a
Open centre system	82.00a	84.00a	238.00b	242.20b
LSD at 5%	4.08	3.00	1.54	3.12

Means sharing a common letter within columns do not differ significantly.

Table 4. Yield and TSS of Double Red Lebanon apple cultivar as affected by various training techniques.

Treatments	No. of fruits/plant		Wt. of fruits/plant		TSS (%)	
	1999	2000	1999	2000	1999	2000
Central leader System	150b	130b	36.01c	31.47c	13.00	13.50
Modified leader system	200a	190a	51.84a	53.29a	13.40	13.50
Open centre system	195a	180a	46.41b	43.59b	13.25	13.40
LSD at 5%	0.25	0.24	3.44	3.80	---	---

Means sharing a common letter do not differ significantly.

Yield: Significant differences were found for yield in number of fruit per plant and total fruit weight of the plant for both consecutive years (Table 4). During 1999 maximum number of fruits were counted from the plants which were trained as a modified leader system (200 fruit/tree) followed by open centre system (195 fruit/plant). Minimum numbers of fruit per plant were counted in plants which were trained as central leader system (150 fruit/plant). Similarly crop load of individual trees were also affected in the same fashion as of number of fruits/plant with various training methods.

Statistical analysis of the data revealed that TSS of fruits were found non-significant in different training techniques. Our results fully corroborate with the findings of Stino & Barkat (1979) who reported that the fruit weight was much greater in pruned trees than unpruned trees in peach.

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